



Effect of Sevoflurane on Recovery Time in Patients with Surgery in the Operating Room

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Abstract

Background: In 2020, 234 million hospital clients made use of health facilities in the globe whereas Indonesia had recorded 1.2 million surgeons (World Health Organization, 2020). Sevoflurane is widely used in surgical procedures and its effect on the duration of recovery time needs further study. **Purpose:** It aims to conduct research on how sevoflurane affects recovery time among surgical patients at Santa Maria Cilacap General Hospital and will investigate specific objectives which include patient characteristics (age, gender, type of surgery, duration), recovery time post-sevoflurane, and the effect with a 2% MAC sevoflurane. **Methods:** A one-shot case study pre-experimental design was undertaken with a subject relatively between surgical patients and univariate analysis was conducted to test the distribution of data among all subjects. The number of patients who received a dose of 2% or 3% of sevoflurane were 26 and 30 patients, respectively. **Results:** Patients mostly fall over 35 years old, even with a higher incidence of females than males. Most patients receive debridement and excision surgery. Recovery times would vary from a surgery that lasts about 30 minutes. Statistical analysis shows normal distribution; meanwhile, the intervention has a significant impact on recovery times. The p-value of the pre-experiment one-shot case study is 0.006, which suggests it is statistically significant ($p < 0.05$). **Conclusion:** This study is beneficial to RSU Santa Maria Cilacap in subsequent understanding of the use of sevoflurane in patient care and as an embarking point for further studies on anesthetics and recovery determinants such as comparative studies on inhalation agents.

Keywords: anesthesia, inhalation; sevoflurane; surgical procedures, operative; postoperative

Introduction

Surgery is a medical procedure that involves an incision to access and repair an impaired part of the body, which usually ends with wound suturing [1]. According to data from the World Health Organization, there is a significant increase (12.8%) in the number of patients undergoing surgery each year. It is estimated that there are approximately 165 million surgical procedures performed worldwide each year, with by 2020, 234 million patients undergoing surgery in hospitals worldwide. In Indonesia, in 2020, the number of

surgical procedures reached 1.2 million cases [2].

Data from the Indonesian Ministry of Health (2021) shows that surgery is ranked 11th out of 50 types of disease treatment in Indonesia, with 32% of them being elective surgeries. In Indonesia, around 32% of total diseases require major surgery. Based on Riskesdas data (2020), there were 35,265 patients undergoing elective surgery in West Sumatra, and in 2019, the number of elective surgeries decreased significantly to 26,764 cases. According to the West Sumatra Provincial

Health Office [3], the number of elective surgeries in Padang City reached 10,265 patients, with 5,564 surgeries performed between June and August 2019. Based on data from Maria Cilacap Hospital, in 2020 there were 645 general surgical operations, which decreased to 433 operations in 2021, and 384 operations in 2022. However, in 2023, the number of general surgical operations increased again to 430.

Sevoflurane is an inhaled anesthetic agent frequently used in surgical procedures due to its favorable pharmacokinetic profile, such as rapid induction and relatively short recovery. According to [6] one important aspect of sevoflurane use is its effect on postoperative patient recovery time, which is an important indicator in the assessment of anesthesia quality as well as postoperative recovery. An in-depth understanding of the factors that influence recovery time can help in the optimization of patient care and reduction of the risk of postoperative complications [7].

Conscious recovery time refers to the interval between the cessation of anesthesia and the return of the patient's full consciousness, during which the patient is able to respond to simple verbal commands. In the use of sevoflurane, the recovery time is influenced by several factors, including the concentration administered, the duration of anesthesia, the physical condition of the patient, and the surgical procedure performed [8]. Sevoflurane is known for having a rapid elimination time from the body due to its low solubility in the blood, thus allowing for faster recovery of consciousness than other inhaled anesthetic agents such as isoflurane or halothane.

Sevoflurane is often chosen for its advantages in induction and rapid recovery, which makes it an ideal choice for day surgery or surgical procedures that require a short recovery time [9]. However,

conscious recovery time not only depends on the pharmacological properties of sevoflurane but is also influenced by various clinical and non-clinical factors. For example, patients with comorbidities such as obesity or impaired liver function may experience slower conscious recovery times due to changes in drug metabolism and elimination.

Studies indicate sevoflurane in higher doses can delay the recovery duration. Sevoflurane, in general, has a pretty good recovery profile but pushes the body to take longer to eliminate the drug when given in larger dosages or being used for longer durations, hence longer periods of recovery. Age is another consideration as it is a significant determinant of the recovery duration, where older patients tend to take a longer time to recover [8]. In addition, some research [9] states that women would hasty recover at an age than men, but further studies need to be made on this. In addition, advantages in hemodynamic stability of sevoflurane promote faster recovery [11]. On the contrary, postoperative hypoxia may delay recovery in patients with a lung disease history or respiratory problems due to sevoflurane [8]. At the Santa Maria Cilacap General Hospital, the average recovery time was about 18 min, while major surgeries would take more than that (7). This study sought to determine the effects of sevoflurane on recovery time concerning surgical patients at RSU Santa Maria Cilacap, using sevoflurane as inhalational anesthesia.

Methods

The type of research is a post-test using a one-shot study design. In this design there is one group that is randomly selected, and then given a pretest to determine the initial situation, is there a difference between before and after the use of sevoflurane This research was conducted in

the Operating Room of Hospital Santa Maria Cilacap, Jalan Ahmad Yani no 38, Cilacap. The research time was conducted in February - March 2024.

The estimated population in this study is an average of 100 patients per month in one year with surgical actions at Santa Maria Cilacap Hospital. Sampling must be such that it can represent the population (representative). The sample size in this pre-experimental study uses total sampling where the entire population will be sampled as many as 56.

The inclusion criteria in this study are: Patients with surgical procedures who are willing to become respondents, patients aged 30-50, and patients with general anesthesia techniques. While the exclusion criteria are eliminating/removing subjects who meet the inclusion criteria from the study for various reasons. The exclusion criteria in this study are: non-surgical patients who are willing to become respondents, patients not aged 30 - 50th, and patients not using general anesthesia technique. The independent variable in the study was sevoflurane. The dependent variable in this study is the time to recover consciousness.

Findings

Characteristics of patients with surgery in the operating room of Santa Maria Hospital Cilacap based on age, gender, type of surgery, sevoflurane dose, length of surgery.

Table 1 Distribution of data characteristics

Variable	Frequent	Percentage (%)
Age		
< 21 years	11	19.6
21-30 years	12	21.4
30-35 years	2	3.6
> 35 years	31	55.4
Total	56	100

Gender		
Female	34	60.7
Male	22	39.3
Total	56	100
Type of Surgery		
Excision	26	46.4
Debridement	28	50.0
Incision	2	3.6
Total	56	100
Sevoflurane dosage		
2%	26	46.4
3%	30	53.6
Total	56	100
Length of Operation		
< 1 Jam	51	91
1 – 2 Jam	5	9
Total	56	100

Based on table 4.1 and data obtained from Santa Maria Cilacap Hospital, the characteristics of patients based on age show that the majority of patients who undergo surgery are more than 35 years old, with a percentage reaching 55.4%. Patients aged 21-30 years with a percentage of 21.4%, while patients aged under 21 years and 30-35 years were 19.6% and 3.6% respectively. This shows that surgery is more commonly performed on adult and elderly patients in this hospital.

The gender distribution of patients showed that more females underwent surgery than males. Females accounted for 60.7% of the total patients, while males only accounted for 39.3%. This difference may reflect disease prevalence patterns or the need for certain surgical procedures that are more common in women.

Based on the type of surgery, debridement and excision were the most commonly performed, at 50% and 46.4% respectively. Meanwhile, incision was the least common type of surgery, at only 3.6%. The use of sevoflurane as an anesthetic agent showed that 53.6% of patients received a 3 mg dose, while the other 46.4% received a 2 mg dose. This suggests a preference for the use of higher doses for the majority of patients which may aim to achieve a deeper anesthetic effect or be

appropriate for the type of surgery performed.

The length of surgery varies, but most commonly lasts for 30 minutes, with 37.5% of patients undergoing surgery within this duration. However, there were also operations that lasted shorter or longer, with times ranging from 15 to 60 minutes, reflecting variations in the complexity of the surgical procedures performed.

Time to regain consciousness after sevoflurane administration

The recovery time after sevoflurane administration can be seen in table 4.2 including the mean, standard deviation, minimum, and maximum values.

Table 2 Duration of recovery to consciousness after sevoflurane administration

Variable	Mean±SD		
		Min	Max
Duration of recovery	18.30±5.13	8.00	25.00

The average recovery time was 18.3077 minutes, while the standard deviation was 5.13784 minutes. The fastest recovery time was 8 minutes, while the longest recovery time was 25 minutes. The criteria used and generally assessed during observation in the recovery room are skin color, consciousness, circulation, respiration, and motor activity.

Analysis of the effect of sevoflurane on recovery time in Santa Maria Cilacap General Hospital.

In this study, a normality test was performed to determine whether the data to be analyzed were normally distributed or not. The data analyzed came from the performance results of the independent variable (X) and the dependent variable (Y). This normality test was carried out

using the Kolmogorov-Smirnov method. Here is how to determine the results of normality testing. If the Sig value. > 0.05, then the data is normally distributed. If the sig value. <0.05, then the data is not normally distributed. The normality test results are presented in the following table.

Tabel 3 Hasil *one-sample kolmogorov-smirnov test*

<i>One-Sample Kolmogorov-Smirnov Test</i>	
N	P
56	0.336

Based on the results above, the Monte Carlo significance value (sig value) is 0.336. This value meets the normality requirements, namely the sig value > 0.05. Therefore, it can be concluded that the data on each variable is normally distributed. It can be concluded that in this test there is an effect of 2% MAC sevoflurane on recovery time in Santa Maria Cilacap General Hospital.

Table 4. 1 Hasil *one-shot case study*

<i>One-shot Case Study</i>	
Test Value	Nilai Signifikasi
20	0.006

The sig value in the test results above, the sig value shows the result of 0.006. This result shows that the pre-experiment one-shot case study is significant because the sig value <0.05.

Discussions

The characteristics of patients undergoing surgery at RSU Santa Maria Cilacap were analyzed based on factors such as age, gender, type of surgery, and duration of surgery. Among the 56 respondents, the majority were over the age of 35, comprising 31 individuals (55.4%). Twelve respondents (21.4%) were in the

21-30 age range, while 11 respondents (19.6%) were below 21 years old. Only 2 respondents (3.6%) were aged between 30 and 35 years. These results highlight that the majority of the participants in the study were older than 35, with smaller proportions of younger individuals. Gender distribution showed that 34 participants (60.7%) were female, while 22 participants (39.3%) were male, indicating a higher participation rate of females compared to males. Age is a crucial factor influencing recovery, particularly in pediatric and geriatric patients. As noted by Meilana (2020), elderly patients often experience chronic illnesses, which significantly increase surgical risks. In geriatric patients, it is recommended to reduce the dosage of anesthetic agents, including sevoflurane, due to the potential for adverse effects on bodily systems [15,16].

In terms of surgery duration, the most common operation time was 30 minutes, observed in 21 cases (37.5%). Surgeries lasting 45 minutes occurred in 13 cases (23.2%). Other surgeries had varying durations between 15 to 60 minutes, with frequencies ranging from 1.8% to 8.9% for each period. Notably, surgeries lasting 35 minutes and 42 minutes were recorded only once, representing 1.8% of the cases. These findings suggest that most surgeries were completed within the 30 to 45-minute timeframe. Regarding anesthetic dosage, 53.6% of patients received a 3 mg dose of sevoflurane, while 46.4% were administered a 2 mg dose.

The average time for recovery after sevoflurane administration was 18.31 minutes, with a standard deviation of 5.14 minutes. The fastest recorded recovery time was 8 minutes, while the longest recovery took 25 minutes. Factors such as residual anesthetic effects, enhanced solubility of inhaled anesthetics, and prolonged action of muscle relaxants are believed to delay the recovery process [27-19]. Additionally, the

type of induction agent used can impact recovery time. Research indicates that recovery is faster when using sevoflurane compared to propofol. This finding is consistent with [4] research, which suggests that patients should typically regain consciousness within 30 to 60 minutes after general anesthesia. One of the primary causes of delayed recovery is the residual effect of anesthetic drugs, which can be exacerbated by preoperative medications [20].

The normality test, conducted using the Kolmogorov-Smirnov method, resulted in a significance value of 0.336, indicating that the data were normally distributed. Therefore, the assumption of normality for regression analysis was met, allowing for further analysis with confidence. The pre-experiment analysis using a one-shot case study model produced a significance value of 0.006, indicating that the intervention had a significant effect. Sevoflurane, known for its fast induction and maintenance compared to other inhalational anesthetics, is generally stable and does not induce arrhythmias during anesthesia. However, it may cause slight hypotension due to a decrease in vascular resistance and cardiac output, which can influence recovery time [21]. Recovery from general anesthesia should ideally be well-controlled, with patients regaining consciousness within 30 to 60 minutes. Delayed recovery, particularly beyond 15 minutes, is often associated with residual effects of anesthetics, sedatives, or complications such as hypothermia, metabolic disturbances, or perioperative stroke [22]. Studies conducted by [23] indicate that typical recovery times range from 15 to 30 minutes, with some patients experiencing prolonged recovery times due to complications related to anesthesia.

Additionally, research by [24,25] compared recovery times between sevoflurane and desflurane, revealing that

patients who received desflurane had faster recovery times, with an average difference of 1.342 minutes. Moreover, the use of midazolam as premedication in sevoflurane anesthesia can extend recovery time, as it influences the pharmacodynamics of anesthetics, thereby prolonging the time to regain consciousness [7].

Limitations

A number of limitations exist which need to be kept in perspective during the interpretation and application of this study for the future. First, this study was conducted in one single hospital so generalization from the sample to a larger population is quite limited. Second, the pre-experimental design with a one-shot case study limits causal conclusions by the absence of a control group. Third, the patient sample primarily consisted of older adults above 35 years of age and a higher proportion of women; this may have implications for the applicability for other age or gender groups. Future studies will require multiple hospitals and stronger experiments such as randomized controlled trials and examination of more factors influencing recovery time and anesthetic doses.

Conclusion

Based on the research in the operating room of RSU Santa Maria Cilacap, patients undergoing surgery were mostly aged 35 years and above, of which males represented a less significant population. The most common surgery performed was debridement or excision, and sevoflurane was reported to be the most commonly used anesthetic agent with few dosage variations. Most surgeries seemed to last about 30 minutes, with recovery times after administration of sevoflurane measured. Analysis with statistics showed that the distribution of data was normal, and treatments applied in the study had a

significant effect on the tested variables. Though the study had limitations with some inaccuracies, it is hoped that it will provide insight to RSU Santa Maria Cilacap in the use of sevoflurane. Furthermore, such research is expected to serve as a reference for further academic research to propel studies into other influencing variables, such as comparisons with other inhalation anesthetics, and to lay the groundwork for larger future undertakings.

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Conflict of Interest Statement

The authors have confirmed that they have no competing interests.

Data Availability

The datasets used or generated in this study are available from the corresponding author upon reasonable request.

Author Contributions

Bunga Christy: Conception and design of the study, Search Data Base, Methodology, Analysis Risk of Bias, Data Analysis and Interpretation, Writing, Review and Editing. **Asmat Burhan:** Study conception and design, search database, methodology, data analysis and interpretation, and writing, review, and editing. **Tophan Heri Wibowo:** Conception and design of the study, Search Database, Methodology, Data Analysis and Interpretation, Writing, Review, and Editing.

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